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Abstract Liposuction is one of the most common aesthetic procedure used in plastic surgery. Reports are available on the results, the probable complications, and the feedback of patients. However, systematic studies dealing with these aspects using reliable large-enough data are still needed. The data comprised 116 procedures during a 6-year period up to 2005. The data were processed and categories of results were formed. Furthermore, a follow-up examination and a survey on the feedback of patients were carried out. Significant differences were identified in indications, results, and complications. The follow-up examinations and the survey showed satisfying results. In the majority of cases, surgeons were satisfied with the operations. In conclusion, if conducted by qualified surgeons in appropriate surgical conditions and postoperative care possibilities, liposuction may be considered as a reliable surgical procedure. The success of this procedure depends, however, on suitable infrastructure and operative competence.

Keywords Liposuction · Evaluation · Complications · Satisfaction · Self-esteem

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Introduction

Since its introduction by Dujarier [1] in 1921, liposuction has become one of the most common aesthetic procedures. Traditionally, liposuction was performed as a dry technique. Beginning in the early 1980s, the use of saline with epinephrine was introduced in what is known as the tumescent technique. More recently, the use of ultrasound has been adopted to liquefy the adipose tissue. This tissue can then be extracted using relatively low suction with less morbidity for the patient. Several studies have attempted to evaluate these techniques, looking at the incidence of complications and patient satisfaction [3–10]. However, the number of patients involved in these studies is low, and both objective and subjective data evaluating patient satisfaction and quality of life is lacking. Furthermore, we do not have any information on which patient characteristics and comorbidities may influence outcomes or predict postoperative complications. In this study, we conducted a retrospective review of 116 liposuction procedures performed at our institution between 1999 and 2005 using tumescent technique. We looked at complications related to this procedure, and we prospectively provided a questionnaire designed to evaluate patient satisfaction.

Patients and methods

Demographics

We performed a retrospective review of all liposuction procedures done at the University Hospital of Zurich between February 1999 and January 2005. Inclusion criteria were patients 16 years of age or older requesting liposuction for aesthetic reasons, with excess adipose tissue

causing functional impairment or demonstrating accumulation of adipose tissue secondary to an underlying disease process. The latter category includes gynecomastia and lipodystrophy caused by human immunodeficiency virus (HIV) (Fig. 1). Exclusion criteria were the involvement of more than two regions, malignant disease, the coexistance of any inflammatory disease, and pregnancy. One hundred and sixteen patients were identified and enrolled in the study. Patients were assigned to one of two groups: those undergoing an aesthetic liposuction procedure (Group A), (Fig. 2), and those undergoing a non-aesthetic liposuction procedure (Group B).

Surgery

After informed consent liposuction was performed, preoperative photographs were used for liposuction planning. Patients were marked preoperatively while standing. General endotracheal anesthesia was administered. Patients were positioned on the operating table in either the supine or prone position, depending on the area to be treated. The infiltration technique with 1 ml adrenaline, 200 ml aqua dest., and 500 ml of Sodiumchlorid 0.9% was used for the infiltration. After complete infiltration, suction-assisted liposuction was performed with a liposuction machine, according to the patient's requirements. Infiltration was accomplished in a symmetric manner in the different parts of the body. Measurement of the amount of infiltrated fluids and the lipoaspirated material was performed at the end of operation.

Short-term follow-up

Patients were evaluated in clinic at 2 weeks postoperatively. Subjective data was collected during the patient interview regarding relief of symptoms and patient satisfaction. A visual analogue scale (VAS) was used to evaluate patient satisfaction on a scale of 1 to 6. Objective data was obtained through physical examination. Changes in the skin and subcutaneous tissues were evaluated for the presence or absence of unevenness, asymmetry, skin overplus, dog ears, scar contracture, edema, tenderness, herniation, paraesthesia, and folliculitis.

Long-term follow-up

Two years postoperatively, patients were sent a detailed questionnaire regarding symptoms, further complications and treatment, quality of life, and patient satisfaction. Patient preoperative and postoperative self-esteem was graded on a visual analogue scale (VAS) from 1–6. Patient satisfaction was evaluated using the same VAS as what was done at short-term follow-up for comparison. Data was also collected regarding the patients profession and the amount of time off from work after surgery.

Statistics

Patient satisfaction for the two study groups was statistically analyzed using the Wilcoxon matched pairs test. Results were determined to be significant at $p<0.05$. Data are presented as mean (±standard deviation) if not otherwise indicated.

Results

Demographics

One hundred and sixteen patients underwent 197 liposuction procedures. There were 92 patients in group A (86 female, six male) and 24 patients in group B (nine female, 15 male),

Fig. 1 Result before/after liposuction at buffalo neck

Fig. 2 Result before/after liposuction at lipodysmorphy

with a median age of 37 (range, 17 to 63) years. Eighty-one patients (88%) in group A underwent liposuction of two different regions of the body vs 21 patients (87%) in group B. The distribution of procedures for the different regions of the body are listed in Table 1. Before the operation, there was a median body mass index (BMI) of 23.23 kg/m^2 (range, 21.78 to 30.38) in group A and 23.77 kg/m^2 (range, 19.47 to 27.44) in group B.

Early postoperative complications

In group A, the median amount of fluid infiltration was 700 ml (range, 0 to 1,240 ml) and the median amount of fluid aspiration was 1,200 ml (range, 190 to 2,630 ml), resulting in a median amount of 500 ml (range, 190 to 1,390 ml) of aspirated fat. In group B, the median amount of fluid infiltration was 40 ml (range, 20 to 980 ml) and the median amount of fluid aspiration was 540 ml (range, 130 to 1,430 ml), resulting in a median amount of 140 ml (range, 110 to 450 ml) of aspirated fat. We had seven patients (6%) with early postoperative complications—five patients in group A and two patients in group B. Three patients (two patients in group A and one patient in group B) presented with seromas requiring surgical evacuation. Three patients in group A suffered from immediate postoperative bleeding. They were treated with pressure dressings and were resolved after 2 days. One patient in group B developed a wound infection after abdominal liposuction, 2 days postoperatively. The infection was successfully treated with oral antibiotics. At 2 weeks postoperatively, all of the complications had resolved, and there was no recurrence. There were no side effects related to any of the analgesic or anaesthetic agents used.

Table 1 Area of surgery

	Group A, *n* (%)	Group B, *n* (%)	Total *n* (%)
Submental	2 (2)	1 (4)	3 (3)
Breast	1 (1)	7 (29)	8 (7)
Abdomen	27 (29)	2 (8)	29 (25)
Iliac crest	26 (28)	4 (17)	30 (26)
Lumbal area	2 (2)	2 (8)	4 (3)
Gluteal region	3 (3)	0 (0)	3 (3)
Trochanteric	39 (42)	2 (8)	41 (35)
Other regions of thigh	59 (64)	6 (25)	65 (56)
Knees	14 (15)	0 (0)	14 (12)

Short-term follow-up

At 2 weeks postoperatively, 97 patients (group A, 77 and group B, 20 patients) were seen for the first follow-up in our outpatient clinic. Nineteen patients were lost to follow-up. There were 37 complications (48%) in group A at short-term follow-up. Three patients (4%) complained of persistent pain localized to the surgical area. None of them required any pain medication. Eight patients (10%) complained of diffuse edema. Twenty-five patients (33%) had a postoperative hematoma. There was no pain, swelling, or tenderness associated with the hematoma, and they all resolved spontaneously without treatment. One patient (1%) presented with a dog ear which was successfully treated with compression dressings. There were nine complications (45%) in group B at short-term follow-up. Six patients (30%) presented with painless swelling at the surgical site and three patients (15%) had a postoperative hematoma. All resolved without treatment.

Long-term follow-up

After a median of 2.7 years (range, 0.6 to 5.4), all patients were sent a detailed questionnaire to assess their satisfaction with the procedure. The response rate was 55 patients (47%). In group A, 12 patients (27%) had undergone additional aesthetic surgery procedures, of which nine (21%) involved liposuction. In group B, there was only

one patient (8%) who had undergone additional aesthetic surgery, none of which involved liposuction. Patients in group A returned to work at a median of 14 days (range, 0 to 42 days) postoperatively. Patients in group B returned to work earlier at a median of 4 days (range of 0 to 21 days). Of the 46 patients that presented with complications at short-term follow-up, only 28 patients returned their questionnaire. Of these patients, none of them had any recurrence or persistence of their short-term complications, and none described the development of new complications. However, none of them had described any persistence or development of new complications. Among the remainder of the patients who returned their questionnaire, 37 (48%) patients in group A and nine (45%) patients in group B complained of persistent pain related to the surgical site. In group A, the median VAS of pain intensity was 1 (range, 0 to 3), and in Group B, the median VAS was 0 (range, 0 to 1). There was no significant difference ($p<0.05$) between the two groups.

Patients' satisfaction

The results of the VAS looking at patient satisfaction immediately postoperatively and at the time of the follow-up questionnaire is shown in Table 2. In group A, there is a slight decrease in the VAS from 3.7 to 3.1, but it is not statistically significant for $p<0.05$. In group B, there is an increase in the VAS from 4.7 to 5.5, but this is also not statistically significant. At long-term follow-up, group B patients are more satisfied with their results than group A patients, and this does reach statistical significance ($p<0.05$).

Table 3 illustrates the results of the assessment of patient self-esteem immediately postoperatively and at long-term follow-up. There is no statistically significant change in group A. However, in group B, there is a statistically significant improvement in patient self-esteem over time ($p<0.05$).

Discussion

Liposuction is one of the most commonly performed procedures in aesthetic plastic surgery. In 1983, Illouz published his results of more than 3,000 cases of liposuction [13]. He demonstrated that this technique was a relatively safe and effective means in removing adipose tissue from any superficial location in the body. Since then, several factors have contributed to the growth of this area of plastic surgery. Advances in both medical care and surgical technique have permitted safe and efficient surgical correction of contour deformities. In the last 30 years, the importance of fitness and health and the emphasis placed on youthfulness and beauty have been associated with social acceptance and professional success. Conversely, as described by Pitanguy [17], current lifestyle and dietary excesses, genetic predisposition, pregnancy, and the aging process, contribute to alterations of body contour that result in the loss of the individual's body image. This might lower ones' self-esteem creating a strong psychological motivation for surgical correction [14]. This is especially true in cases where localized fat deposits and skin flaccidity are resistant to the most sincere efforts at weight loss through diet and exercise [17]. Liposuction, performed in hospitals, ambulatory centers, and in the majority of physician

Table 2 Long term follow-up of patients satisfaction

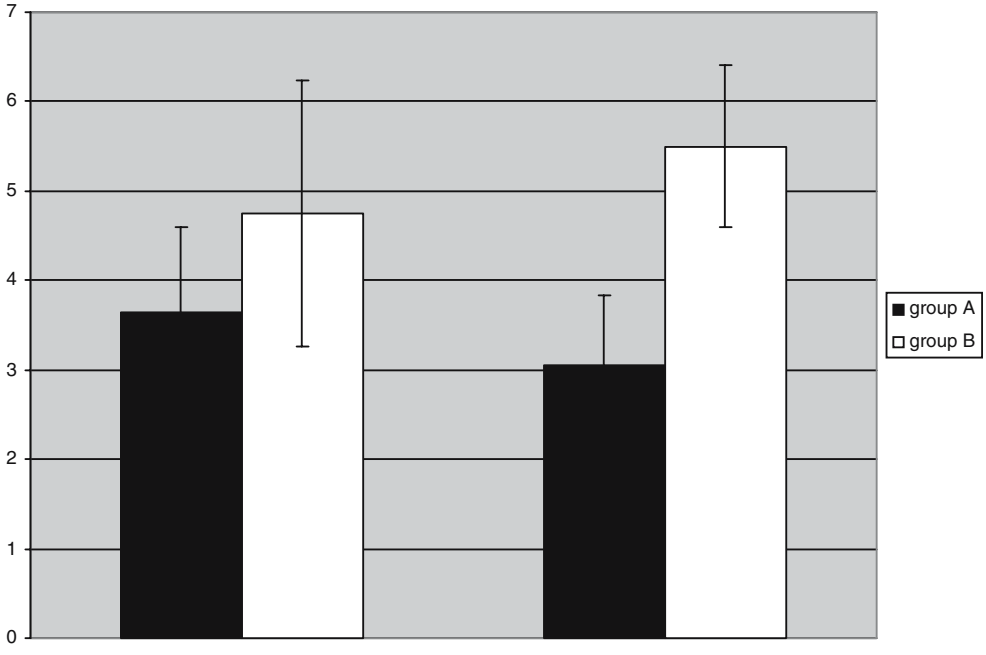
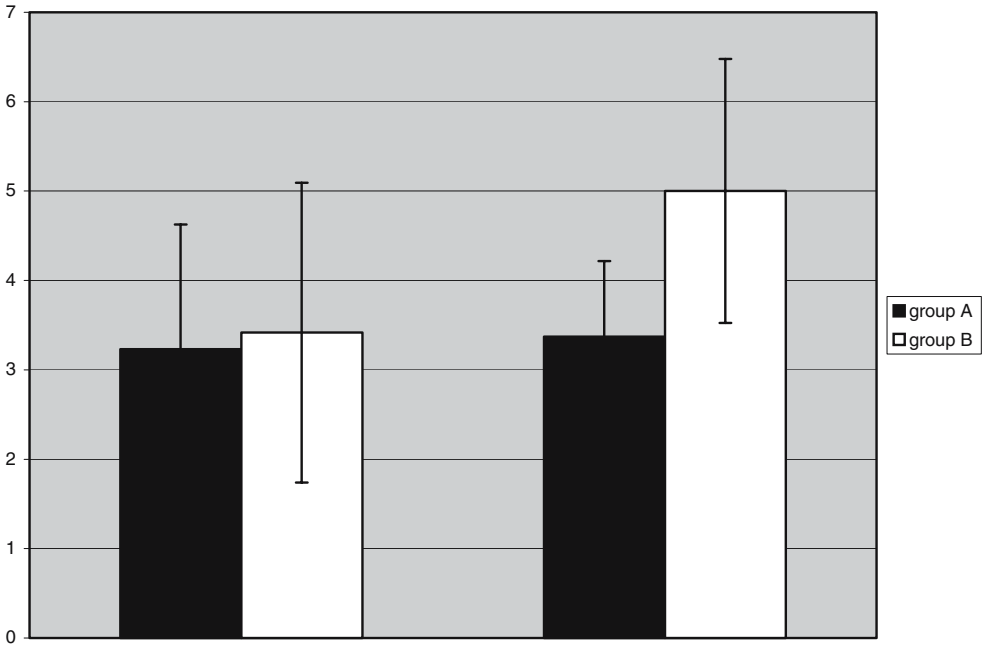


Table 3 Long term follow-up of patients self-esteem



centers, is generally reported as a safe procedure with a low complication rate [1].

Scarborough et al. reported their results of liposuction procedures in more than 5,000 patients using conscious sedation with monitored anaesthesia care [15]. They did not have any significant adverse effects or complications associated with this technique. However, several reports of major complications like pulmonary thromboembolism [1, 19], necrotizing fasciitis [3, 7], fat embolism [5, 16], and death [4, 10, 14] are also found in the literature. Studies focusing on severe adverse effects described mortality rates ranging from 0.003 to 0.02% [4, 5, 13]. Most of this literature is published out of university hospitals. Unfortunately, there is little data concerning the outcomes of liposuction procedures performed in outpatient physician centers. Often, patients with severe complications related to liposuction procedures are admitted to the plastic surgery service of a university hospital, rather than following up with their primary surgeon. The community surgeon may have little follow-up on these patients and is sometimes unaware of when they have a severe complication necessitating further surgical intervention or hospital admission. This state of affairs is taking more and more attention because of the enhanced development of "discount surgery" in different countries with volunteers and dumping prices However, in case of a complication, the primary surgeons is generally not consulted, and the health system and insurance of the domicile must get involved. This poses an even greater concern in today's current healthcare environment where patients are offered "discount surgery" in foreign countries. Should a patient develop a postoperative complication, they are usually treated after returning to their native country, and the cost of these treatments is then absorbed by their countries' national healthcare system.

In our retrospective study, 116 patients underwent a tumescent liposuction procedure between January 1999 and December 2004 at the University Hospital of Zürich. Patients were admitted the day before surgery and discharged on postoperative day 1. All patients were operated by a consultant or a senior resident under supervision. We divided the survey into two groups. Group A consisted of patients who were seeking a purely aesthetic improvement in their appearance. Group B comprised of patients requiring liposuction treatment of medical conditions such as benign symmetric lipomatosis [20], gynecomastia [6], and HIV-associated lipodystrophy [8]. In all patients, we used the same tumescent solution with 1,000 ml of NaCl, 100 ml of 8.4% sodium bicarbonate, 30 ml of 1% lidocaine, and 1 ml epinephrine (1:100,000).

In both groups, no major complications were found. Minor complications consisted of postoperative hematoma, edema, pain at the surgical site, seroma, and superficial wound infection. The overall complication rate was 37% (48 patients). This is higher than what has been previously reported in the literature. Hanke et al. conducted a prospective multicenter study looking at 688 patients who underwent liposuction using a tumescent technique. Their overall clinical complication rate was only 0.7%. Their major complication rate was 0.14%, with one patient requiring hospitalization. Their minor complication rate was 0.57%; however, in our study, we included aesthetic and medical indications as an explanation for the higher overall complication rate. Despite the presence of more comorbidities in group B (e.g. HIV or lipodystrophy), the majority of the complications such as haematoma and pain,

were found in group A. This is likely due to a larger amount of total aspirated fat in group A compared to group B. This translates into a larger operative area resulting in a higher risk for postoperative bleeding, hematoma, and infection.

Our long-term results demonstrate that liposuction for both aesthetic and nonaesthetic indications is a safe and effective procedure. All immediate and early postoperative complications were resolved without sequelae at long-term follow-up. Long-term results also demonstrated a high level of patient satisfaction with their surgeon (90%) and with their overall care (100%). When asked if they would undergo the operation again, 92% of patients surveyed answered "yes". With regard to patient satisfaction, our results are comparable to those reported by Hanke et al. and Goyen et al. In Hanke's study, a survey was completed by patients at 6 months postoperatively aimed at assessing patient satisfaction with their liposuction procedure. Of the 59% of patients who responded to this survey, 91% had positive remarks about their decision to have liposuction and 84% had high levels of overall satisfaction [11]. In Goyen's survey of 123 patients using a standardized questionnaire, the time elapsed since surgery did not influence the outcome with regard to the patient satisfaction. Goyen reported that a large proportion of patients experienced positive lifestyle outcomes from the procedure: 80.5% were more confident, 74.8% experience an increase in self-esteem, and 87% were more comfortable in clothes [9]. Goyen et al. also looked at patient satisfaction as it related to weight gain after liposuction procedures. Their results showed that regardless of whether or not the patients regained the weight, they were all equally satisfied with the results of their surgery. Our study does not support this range of general satisfaction of patients at long-term follow-up. Instead, there was higher patient satisfaction and self-esteem at long-term follow-up in group B. Although not all of the results reached statistical significance, there was a tendency towards poorer outcomes in the patients undergoing liposuction for aesthetic purposes. This may be a reflection of a difference in patient expectations. According to Rohrich et al. [18], patients need to have realistic expectations for long-term successful body contour results. Interestingly, 27% of patients in group A had further aesthetic surgery after the initial operation, including 21% who had additional liposuction. This suggests, given that the majority of the patients were satisfied after their index procedure, that their motivation for seeking out a surgical solution to their body image/self-esteem problem persisted despite the liposuction procedure, causing them to seek out additional surgical solutions.

Conclusion

The study is limited by the retrospective nature of the data collection with regards to early and immediate postoperative outcomes. In addition, one of the major drawbacks concerning the long-term data is the 47% response rate. In general, statistics dealing with patient satisfaction need to be interpreted cautiously as they are prone to multiple biases and depend on the method of evaluation of the data.

There are four key elements for long-term satisfaction after liposuction in body contouring. The patient is responsible for the first three: exercise, a proper diet, and positive lifestyle change. The surgeon is responsible for the fourth: a well executed body contouring procedure [18]. In our opinion, this includes good postoperative care and long-term follow-up. If these conditions are met, we believe that liposuction can be a safe and effective procedure with predictable outcome, a low complication rate, and a high level of long-term patient satisfaction. We believe that our data supports this conclusion, although additional well-designed prospective studies focusing on patient outcome are necessary. To do this, a comprehensive method of recording satisfaction of patients from surgery, especially plastic surgery, and a standardized method of analysis of these data are needed.

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